ESO 772

Food-Fuel Conflicts - The Brazil Case

by Norman Rask

Department of Agricultural Economics and Rural Sociology
The Ohio State University

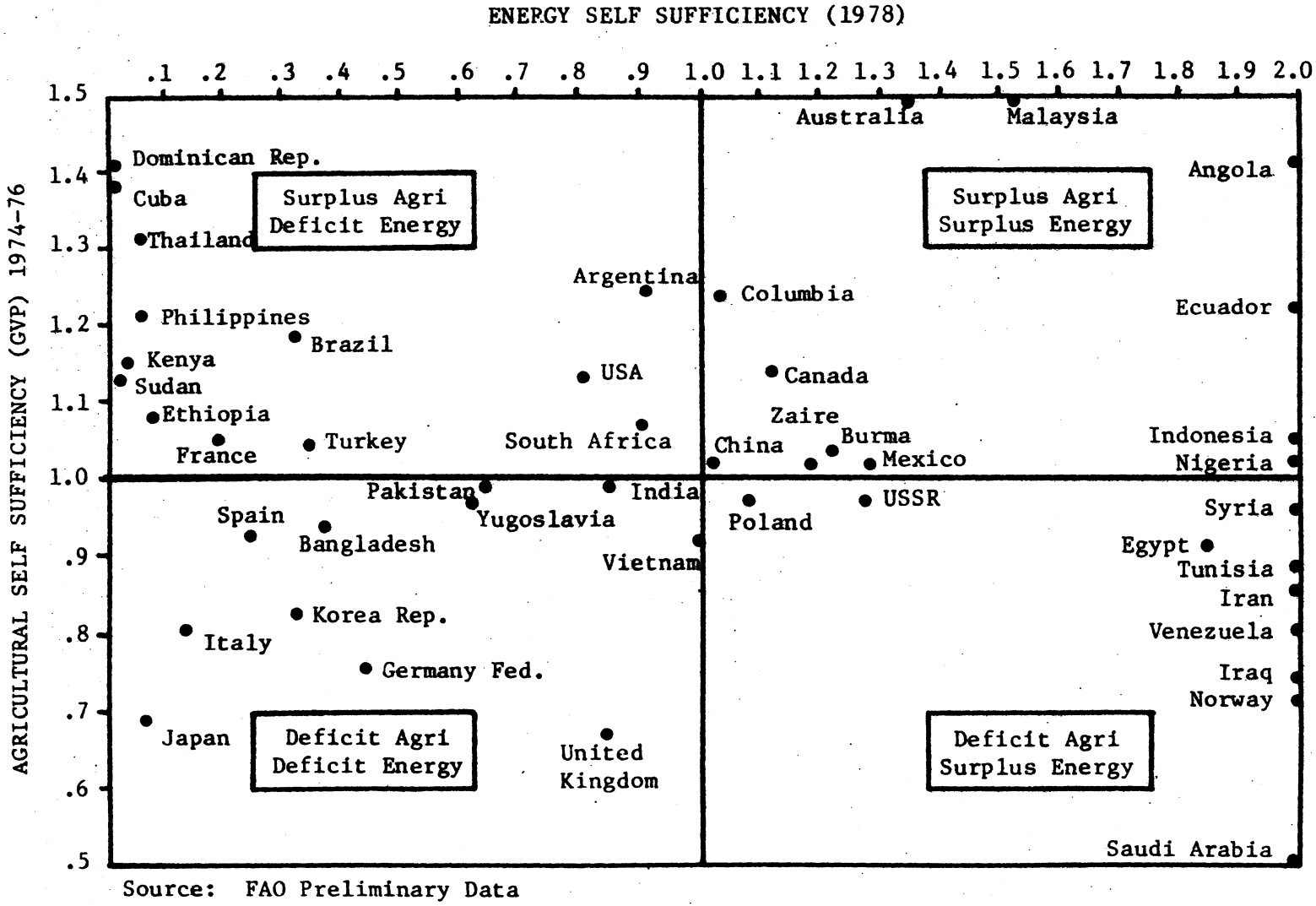
Paper presented at the 1981 Annual Meeting of the Association For the Advancement of Science, Toronto, 308 January 1981.

Feed-Fuel Conflicts - The Brazil Case

Rising energy prices, and increasingly uncertain supply conditions for internationally traded oil, have caused many countries to search for domestic energy alternatives. Alcohol produced from food and feed crops is one readily available liquid fuel alternative. The use of agricultural resources for energy production, however, raises a host of concerns about food supplies and prices, and about the best long run use of limited land resources.

The cumulative impact of individual country alcohol programs will affect world food availability and prices generally. Decisions about alcohol programs, however, are country specific and will be made within each country on the basis of a unique set of food-energy conditions. These will include relative self-sufficiency capabilities in both agriculture and energy production, (figure 1), the specific needs and production of liquid fuels, and the availability of under utilized land resources. As countries differ in the mix of these conditions, choices, relative to the use of agricultural resources will range across a spectrum from early subsidies for alcohol production (before alcohol is competitive with food crops), to relative indifference between food and fuel, to strong protection of agricultural resources for food production [5].

Brazil, because of its' unique agriculture-energy situation, has decided to commit a significant part of its' agricultural resources to the production of sugarcane and other crops to be processed into fuel grade alcohol. The early phase of the alcohol program has been sup-



Source: FAO Preliminary Data

Figure 1. ENERGY AND AGRICULTURAL SELF SUFFICIENCY

supported by very favorable distillery construction subsidies. Presently, annual alcohol production is about four billion liters. This is expected to more than triple by the late 1980s. Concerns are already being raised about potential food-fuel conflicts, especially in the major food-sugarcane producing areas of the state of Sao Paulo and the sugarcane areas of Northeast Brazil.

The objective of this paper is to explore the dimensions of this emerging food-fuel issue in Brazil. It is a complex subject that has received very little study. The energy supply and use situation along with a brief description of the alcohol program are presented first. Current land use in relation to food and export crop production is presented next. This is followed by a description of the energy crops to be used for alcohol production. The paper concludes with an investigation of the food-fuel conflicts on a national and regional basis with the identification of some changes in program emphasis that will lessen the impact of the alcohol program on food supplies and prices.

Energy Supply and Use

Brazil has three major sources of energy, petroleum (42%), hydroelectric (25%), and biomass (28%).[1/] Further, 85 percent of petroleum is now imported and both petroleum and electricity use have shown relative gains in recent years. Petroleum imports will cost about $12 billion in 1980, roughly one-half of Brazil's total import bill.

Several measures have been instituted to reduce reliance on imported oil. Some increase in domestic production of oil is forecast, though this will only keep pace with increased demand. The two principal changes call for an 80% increase in hydroelectric capacity and a major substitution of alcohol for gasoline. Current annual production of about 4 billion liters

of alcohol is expected to increase to 10.7 billion by 1985 and will then account for about one-half of the "gasoline" demand in the form of both "gasohol", a 20% blend of alcohol with gasoline, and pure alcohol burned in specially modified engines. The goal is to eventually replace all imported petroleum with alcohol and other domestic substitutes such as vegetable and palm oils.

Over the past several decades, Brazil has committed itself to a motor vehicle transportation system, and a substantial area of mechanized agriculture. In the face of sharply higher energy prices, they have elected to continue this system, and reduce the impact from imported oil by turning to their agriculture sector for domestic substitutes.

The Alcohol Program

Brazil has traditionally produced alcohol as a by-product of a large sugar industry and historically used most of this alcohol in low concentration mixtures with gasoline. In 1975, they embarked on a major alcohol program with a long term objective to provide self-sufficiency in the production of liquid fuels. They have set ambitious targets and with an established sugarcane industry and attractive subsidies have been able to meet early goals. Current alcohol production of 4 billion liters annually, represents a six fold increase over 1975 levels and accounts for about one-fourth of the 1980 "gasoline demand." Since alcohol-gasoline mixtures cannot exceed 20 percent alcohol, the additional alcohol production must be used in pure form. Approximately one-third of new cars produced have pure alcohol engines. This percentage will increase as higher alcohol production levels are reached.

The goal of 10.7 billion liters by 1985 will probably be achieved. It will require a land area equal to seven percent of current cropland (table 1). Substitution for all imported petroleum would require a land area equal to almost 40 percent of current cropland. Land development, pasture

Table 1 Brazil - Alcohol Production Goals and Associated Land Needs

Alcohol Production Goals	Sugarcane Land Needed 1/	
	Hectares (000,000)	as percent of present cropland (%)
1980 - 4.0 billion liters	1.1	3
1985 - 10.7 billion liters	3.1	7
1988 - 14.5 billion liters	4.1	9
If substituted for:		
All gasoline (1980)	4.7	10
All imported petroleum (1980)	17.5	39
All petroleum (1980)	20.6	46

1/ Based on an estimated cropland base of 45 million hectares and an alcohol yield of 3500 liters per hectare annually. Use of cassava as an energy feedstock may increase the land requirement.

conversion, alternative crop selection, and changes in petroleum demand will of course change the magnitude of these numbers as the higher goals are approached. However, it is clear that pressure on land use will be intensive as the alcohol program progress beyond present levels.

Land Use and Availability

Brazil has a large agricultural land base. Most major food and industrial crops are produced in excess of domestic needs. Overall, crop self-sufficiency is 1.25, indicating that crop production is 25 percent greater than domestic demand (Table 2). The degree of excess production varies by crop. Black beans, cassava, corn and rice, the traditional subsistence crops are produced principally to satisfy domestic needs.2/ They occupy about 50% of the cultivated area. Wheat production is not well adapted to Brazilian growing conditions, consequently only one-half of domestic needs are met from local production. Soybeans, sugar, coffee, cocoa and other industrial crops are the principal export products and show high self-sufficiency ratios. They account for about 35% of the cropped area. All crop and livestock production show a surplus above domestic needs of about 18 percent.

Brazil has large pasture areas and livestock numbers. The total pasture area is four times as large as the cropped area. Also, about 40 million pasture hectares, have been improved, indicating that this land has been worked and could be available for cropping with little additional investment. The quality and availability of the remaining 126 million hectares of pasture land in terms of crop production is unknown, though much of this area is found in regions of poor soils and limited rainfall.

Table 2 Brazil: Land use and agricultural self-sufficiency ratios for selected products.

Land Use	Millions of hectares (1978)[1/]		Self-sufficiency Ratio (1974-76) [2/]
Cereals and legumes			
Corn	11.1		1.08
Soybeans	5.8		3.30
Rice	5.6		1.01
Beans	4.6		.99
Wheat	2.8		.50
Other	.5		n.a.
	30.4		1.06
Other crops			
Sugar	2.4		1.23
Cocoa	2.2		5.98
Cassava	2.1		1.05
Industrial crops	5.6		2.12
Other	2.2		n.a.
	14.5		1.34
Total crops	44.9 [3/]		1.25
Pasture			
Improved	40.0	(livestock)	1.02
Natural	126.0		
Total Agriculture			1.18

[1/] IBGE (3)

[2/] FAO Preliminary data (1)

[3/] Total area in crops overstates somewhat the cultivated land base due to double cropping. 1975 census indicates 40 million hectares of cropland.

In a general sense, the excess production of agricultural products (18%), plus the potential for expanding the crop area further on to improved pasture land (more intensive use) provide a favorable agricultural environment within which to mount an alcohol program. There are some trade offs depending on where the energy crop farming occurs. First, if initial displacement is in areas of food crop production with present self-sufficiency ratios of about 1.0, there will be short run food shortages and higher prices. Similarly, substitution of export crops by energy crops would reduce exports. It is likely that in the long run, both food and exports crops would be re-established on present pasture land. Thus, ultimately, the major change would result in more intensive use of pasture land with some upward pressue on all agriculture product prices.

Energy Crops

A number of agricultural products can be used for alcohol production. Brazil is concentrating initial emphasis on sugarcane. Cassava and sweet sorghum hold future potential, though both agricultural and processing technology need further development. In addition to alcohol crops, several vegetable oil crops are being considered as diesel oil substitutes.

Sugarcane has been planted commercially in Brazil for many years. In requires fertile land and good rainfall, and therefore competes strongly with food and other export crops for prime agricultural lands, especially in the state of Sao Paulo, where about 40 percent of the sugar cane is grown. A second major sugarcane area is located in the humid coastal region of Northeast Brazil. The sugar cane plantation

system used in Brazil is based on large land holdings and capftal intensive technology (mechanization, fertilization). Harvest is carried out over a six month period (June to November) utilizing seasonal labor, principally for cutting the cane.

Sugarcane offers many advantages as an energy feed stock for alcohol production. First, within Brazil, there is a long tradition and experience with sugar and alcohol production including institutional and infrastructure support. A major capital goods industry is available to supply distilleries. Sugarcane is an energy efficient feed stock since the crushed stalk (bagasse) supplies all the energy needed to convert sugarcane to alcohol. The yield of alcohol per hectare is greater with sugarcane than with other alternatives presently available. These factors all point to a rapid start up capability and are responsible for the initial emphasis on sugarcane as an alcohol feed stock.

These advantages need to be balanced against some potentially negative factors. The regional specific and large size characteristics of sugarcane production will likely increase existing regional inequalities and lead to further land concentration in the sugarcane expansion areas (Table 3). Short run food and export crop shortages (and higher prices) are likely to coincide with a rapid build up of sugarcane acreage in Sao Paulo and the Northeast.

Cassava - Brazil is the major producer of cassava, a root crop that is used primarily as a subsistence food crop. Technical practices, and soil, climatic, and moisture tolerance levels stand in sharp contrast to sugarcane. It is grown generally on poorer land, with low technology inputs by small farmers. Cassava, is adaptable to a wide variety of

Table 3 Sugarcane, Cassava, and Annual Crop Area by Farm Size - 1975

Farm Size (hectares)	Cassava	Sugar cane	All Annual Crops	Cassava	Sugar cane	All Annual Crops
	(000 hectares)			Percent		
Less than 10	584	72	4859	45	4	16
10-49	464	209	9273	36	11	29
50-199	187	275	6801	14	15	21
200-999	59	735	6718	4	39	21
1000+	13	570	3965	1	31	13
all farms	1307	1860	31,616	100	100	100

Source - 1975 Census

soil and climatic condition and is grown throughout Brazil. It can be harvested during all months of the year and/or chipped and dried for storage and less expensive transport. The largely hand labor technology lends itself to small farm family operations. Little research support has been directed toward cassava, and since it is a subsistence crop, there has been little institutional support developed. Technology for converting cassava to alcohol is still in the development and pilot plant stage.

On the positive side, year round distillery operation, broader geographical distribution, less food conflict for land use and better rural employment and small farm development possibilities favor the use of cassava over sugarcane. This has led some to feel that long run goals for alcohol production will rely strongly on a significant contribution from cassava. The negative factors are the presently low yield levels and the need for an outside fuel source for processing the cassava into alcohol. Initial research work on increasing cassava yields through variety selection and improved management practices has provided encouraging results. Sweet sorghum is a potential energy crop that has no historical experience in Brazil, but holds great promise for the future. It combines positive elements of both sugarcane and cassava and may be the least competitive for land use over at least a modest level of production. It is a short season crop that can produce two harvests per year in most areas of Brazil and thus provide a year round supply of energy feed stock to distilleries. Like sugarcane, the crushed stalk provides process energy. It is adaptable to most regions of the country and will produce well in semi-arid regions.

Sweet sorghum also produces some grain along with the stalk. Experimental plots nave demonstrated grain yields approaching those of corn.[3/] Thus, it is potentially feasible to substitute sweet sorghum for corn, produce both energy and feed, and not put undue pressure on land resources, at least within the limits of a portion of current corn acreage. Alternatively, both the stalk and grain can be used to produce alcohol at potential per hectare alcohol yields greater than sugarcane. Many technical and cultural problems have yet to be overcome in the growing, harvesting and processing of sweet sorghum. As these developments proceed, sweet sorghum will likely become a significant factor in meeting future alcohol goals.

The Food-Fuel Controversy

There is a growing debate in Brazil, over the actual and potential impact alcohol production will have on food supplies and prices. This concern is directly largely to the North central part of the state of Sao Paulo, where projected sugarcane plantings will approach 60 percent of presently cultivated land and to several states in the Northeast where sugarcane will increasingly dominate land use. With approximately one-half of the 1985 alcohol target capacity of 10.7 billion liters, now in operation or approved for construction some trends are emerging.

The Northeast as a region will be committing an area equal to six percent of the present cultivated area to energy crops (Table 4). The state of Alagoas is especially concentrated with an energy crop commitment equal to 33 percent of current cropland area. Similarly, the Southeast region with a commitment equal to 7 percent and Sao Paulo state with 11 percent of current cropland committed to energy crops is

Table 4 Brazil: Land Availability and Needs for Alcohol Production by Selected States and Regions

State and Region	Cropland available (1975) 1/	Land needed for alcohol projects approved (6-30-80) 2/	
	(1)	(2)	2/1
	hectares (000,000)		
North	1.2	.02	.017
Northeast	11.0	.60	.055
Alagoas	(.7)	(.24)	.327
Southeast	10.4	.72	.069
Sao Paulo	(5.2)	(.56)	.108
South	13.0	.11	.008
Center West	4.4	.10	.024
Brazil	40.0	1.55	.039

1/ 1975 Census

2/ Approved projects as of 6-30-80, represent about 5.6 billion liters annually or slightly greater than one-half of projected operating capacity of 10.7 billion liters by 1985.

experiencing pressure on land use.

As noted earlier, land for energy crops will not necessarily be taken from present crop land, since a substantial amount of less intensively farmed land (pasture) is available in most areas. A recent study of the impact of increased sugarcane plantings in Sao Paulo state over the 1974-79 period suggests that pasture land substitution accounted for 65 percent of the new cane area, food crops for about 16 percent, corn 12 percent and industrial crops, 7 percent [2]. Programming model results for the southern region of Brazil demonstrate that similar changes would be expected, including minor reductions in the area devoted to food and export crops with the bulk of the substitution occurring with pasture land [4, 6].

These and other ongoing studies suggest interesting cost-resource use relationships between sugarcane, cassava and sweet sorghum as alternative energy feedstocks. As noted earlier, sugarcane yields higher levels of alcohol per hectare, resulting in greater net returns per unit of land. Sweet sorghum produces both grain and alcohol. Thus in situations where land is a limiting factor, sweet sorghum is generally the preferred feedstock at production levels where the sorghum grain can substitute for corn. Beyond this level, sugarcane provides the least competition for land use. Cassava, on the other hand has lower variable costs of production per unit of alcohol produced. Thus, in areas of low cost labor, and abundant land (pasture) cassava is often the preferred crop for a fixed quantity of alcohol production.

The results of these studies clearly indicate that alternative crops (to sugarcane) should be given serious study, especially for

regional alcohol markets. Because of the early emphasis on sugarcane in areas of strong competition for land use and its' clear superiority over cassava on these region specific locations, the potential role of cassava (and eventually sweet sorghum) have not been adequately recognized in policy decision.

Brazil is clearly committed to a major alcohol program. Early emphasis on sugarcane as an energy feed stock in traditional food crop areas has raised concerns about food supplies and food prices. As alcohol production goals are raised, and if sugarcane area continues to expand in these regions, the concerns will be realized. A much larger land base, along with regionally adapted crops, such as cassava and sweet sorghum exist. Policy decisions should be taken now to diversify the feedstock source and regionalize production in order to minimize the impact of this substantial alcohol demand for land resources on future food supplies and prices.

Footnotes

1/ Principally firewood and bagasse.

2/ Corn and cassava are also used as principal livestock concentrates.

3/ Corn yields in Brazil are low by international standards.

Bibliography

1. FAO Conference Publication, "Agriculture: Toward 2000", Twentieth Session, Rome, November 10-29, 1979.

2. Filho, Alceu A.V., Elcio N. Gatti and Nilda T.C. Mello, "O Programa Nacional Do Alcool E os Impactos Na Agricultura Paulista," I.E.A., Secretaria da Agricultura, Sao Paulo, Brazil, 1980.

3. I.B.G.E. - "Anuario Estatistico DO Brazil - 1979 - Rio de Janeiro, Brazil 1980.

4. Mattuella, Juvir and Norman Rask, "Aspectos Economicos da Producao de Alcool Na Regiao Sul do Brazil" paper presented at the IV International Symposium on Alcohol Fuels Technology, Guaruja S.P., Brazil, October 5-8, 1980.

5. Rask, Norman, "Biomass: Its Utilization as Food and/or Fuel" Keynote speech, IV International Symposium on Alcohol Fuels Technology, Guaruja - S.P., Brazil, October 5-8, 1980.

6. Rask, Norman and Reinaldo Adams, "Regional Competitiveness of Alcohol Production in Brazil", paper presented at 1979 National Meeting of Latin American Studies Association, Pittsburg, April 5-7. 1979.

7. Saint, William S. "Farming for Energy: Social Options Under Brazil's National Alcohol Program," paper, The Ford Foundation, Rio de Janeiro, Brazil, October 1980.